THE ECOLOGY OF *TRILLIUM TEXANUM* (TRILLIACEAE) ON THE ANGELINA NATIONAL FOREST, TEXAS

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ABSTRACT

Trillium texanum Buckley, a member of the *Trillium pusillum* Michx. complex, is rare over its range, occurring in scattered populations in baygalls, streamsides, and wooded seeps. We collected information on the habitat, phenology, population, and soils of *Trillium texanum* on the Angelina National Forest in southeast Texas.

KEY WORDS: *Trillium pusillum*, *Trillium texanum*, baygall, Angelina National Forest, Texas

RESUMEN

Trillium texanum Buckley, miembro del complejo *Trillium pusillum* Michx., es raro en todo su areal, apareciendo en poblaciones dispersas en arroyos e infiltraciones boscosas. Hemos colectado información sobre su hábitat, fenología, población, y suelos de *Trillium texanum* en el Angelina National Forest en el Sureste de Texas.

INTRODUCTION

Except for taxonomy, morphological variation, and distribution, little is published about the *Trillium pusillum* Michx. complex, of which *Trillium texanum* Buckley (or *Trillium pusillum* Michx. var. *texanum* (Buckley) J. Reveal & Broome), is a member (Kral 1983; Freeman 1994; Cabe 1995; Cabe & Werth 1995; Case & Case 1997; Farmer & Schilling 2002; Singhurst et al. 2002; Timmerman-Erskine et al. 2002a, 2002b). Only a decade ago, Freeman (1994:49) pointed out that "ecological parameters have not been measured in any population of *T. pusillum*." More recently, Singhurst (1996), in his summary of *T. texanum*, stated that not only is there virtually nothing known about *T. texanum* ecologically, there are currently no research programs that include it. Since we now know a great deal about the distribution, morphology, and taxonomy of the *T. pusillum* complex, what would be of interest would be ecological/autecological descriptions of *T. pusillum* over its range. What is known is that all members of this complex are shade plants of moist hardwood bottoms, creek sides, or swamps. They occur on a variety of soils from sandy to cherty-flinty, fertile to infertile, alkaline to basic. They occur in the Appalachians and Interior Highlands and on the Coastal Plain (Kral 1983).

Trillium texanum is rare, occurring in small, disjunct populations (Singhurst et al. 2002). It has been found at several locations in Caddo Parish in northwest Louisiana (MacRoberts 1977; Teague & Wendt 1994) and nine east Texas counties (Nixon et al. 1977; MacRoberts & MacRoberts 1998; Singhurst et al. 2002; Turner et al. 2003). It is rated state critically imperiled in Louisiana and imperiled in Texas and globally rare/imperiled (Louisiana Natural Heritage Program 1999; Poole et al. 2004). Its habitat preference has been variously reported as baygalls and wooded seeps (Ajilsvgi 1979; Teague & Wendt 1994; Singhurst et al. 2002).

From 1995 to 1997, we collected information on population, associated flora, and soils for *T. texanum* on the Angelina National Forest in Angelina and Jasper counties in southeast Texas. General descriptions of the area and edaphic conditions are given in Orzell (1990) and Bridges and Orzell (1989).

METHODS

1. In 1995 and 1996, while conducting overall surveys for rare plants on the National Forests and Grasslands in Texas (MacRoberts & MacRoberts 1998), we surveyed for *T. texanum* by walking baygalls, streamsides, and branchbanks in various mesic to xeric sandy longleaf pine uplands in southern Sabine National Forest, Sabine County, and in southern Angelina National Forest in Angelina and Jasper counties. This was slow work because the plants are rare, scattered, and inconspicuous. On the Angelina National Forest, *T. texanum* puts up only a few early spring (March–May) flowers, and although it puts up many inconspicuous single leaves, these are soon overtopped and hidden by later developing herbaceous species, particularly ferns such as *Osmunda* and *Woodwardia*. Since our time was limited and there are many kilometers of potentially suitable habitat along streams in the area, this survey is not exhaustive.

2. In May 1995, we established seven permanent one meter sq. plots in three *T. texanum* populations. Because of the limited number of known populations the sites were chosen as typical of what we had encountered and were accessible to repeated visits. Number of plants and their developmental stage (e.g., single leaf, three leaves but no flower, three leaves with flower, Fig. 1) were recorded for each plot.

3. To define the plant community in which *T. texanum* occurs, we established two permanent plots centered on two of our one meter sq. plots (called plot 2 and plot 4 hereafter). These were chosen because they were typical and accessible. Each measured 18 m × 13.5 m and was divided into three 6 m × 13.5 m sections running parallel to the topographic/moisture/light gradient (Fig. 2). The upper section (highest elevation) was farthest from the stream course; the lower section was closest to the stream course. In the center of the middle section was the one meter sq. plot with *T. texanum*. We surveyed the flora in each plot every two to three weeks between February and November 1996.

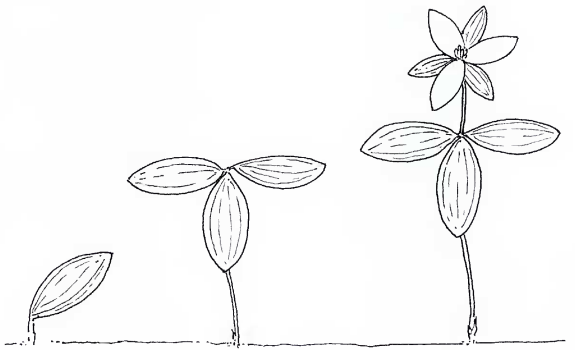

FIG. 1. Above-ground growth forms of *Trillium texanum* (left to right: single leaf, three leaves, three leaves with flower).

4. We collected soil samples to a depth of 15 cm in each of the center plots near the *Trillium* and had them processed at A & L Laboratories, Memphis, Tennessee.

RESULTS

1. We found eight populations of *T. texanum* in Angelina and Jasper counties in the Angelina National Forest. These populations were scattered over an area about 6 km east-west along the Angelina-Jasper county line and were near the headwaters of Trout Creek, Buck Branch, Clear Creek, and Shearwood Creek. These are south-flowing, intermittent streams. The eight populations ranged from a single group of plants consisting of only a few single leaves and scapes occurring within an area less than one meter square to fairly large populations with thousands of leaves and dozens of flowering scapes scattered over a hectare. We did not find *T. texanum* in the Sabine National Forest, although there appeared to be suitable baygall habitat.

The dominant habitat of the whole area where *T. texanum* occurs on the Angelina National Forest is arenic longleaf pine uplands grading into grossarenic uplands (see Bridges & Orzell 1989; Orzell 1990; Harcombe et al. 1993; Turner et al. 1999, for habitat classifications). This area is locally know as Longleaf Ridge. Common upland vegetation of this area consists of *Andropogon ternarius* Michx., *Croton argyranthemus* Michx., *Cnidoscolus texanus* (Muell.-Arg.) Small, *Berlandiera pumila* (Michx.) Nutt., *Dichanthelium aciculare* (Desv.

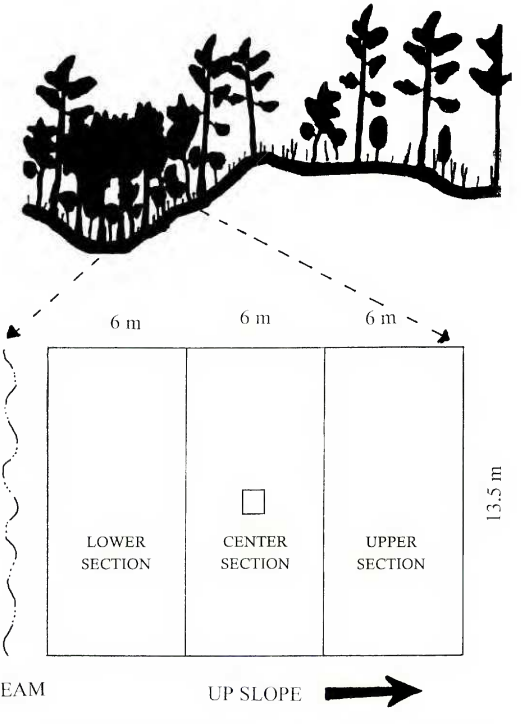

Fig. 2. Study plot layout for plant communities of *Trillium texanum*. Two permanent plots were established, each centered on a one meter sq. plot. Each of the three 6 m × 13.5 m sections of the two plots runs parallel to the topographic/moisture/light gradient. The upper section (highest elevation) is farthest from the stream course; the lower section is closest to the stream course. The center section contains the one meter sq. plot with *T. texanum*.

ex Poir) Gould & C.A. Clark, *Fvaelichia floridana* (Nutt.) Moq., *Ilex vomitoria* Ait., *Pinus palustris* P. Mill., *Pinus echinata* P. Mill., *Pityopsis graminifolia* (Michx.) Nutt., *Pteridium aquilinum* (L.) Kuhn, *Quercus incana* Bartr., *Q. stellata* Wang., *Q. marilandica* Muenchh., *Schizachyrium scoparium* (Michx.) Nash., *Tephrosia virginiana* (L.) Pers., *Toxicodendron radicans* (L.) Kuntze, *Tradescantia reverchonii* Bush, *Tragia urens* L., and *Vernonia texana* (A. Gray) Small.

2. Table 1 gives the data on the developmental stage of plants in the seven one meter square plots. The vast majority of above-ground growth was single leaves, not scapes with leaves or flowers. In the seven plots, there were only 15 flowering stems in three years, and a total of only 31 scapes. This pattern was typical for all *T. texanum* we observed on the Angelina National Forest. In April and May, the ground cover for the seven plots was always below 30%.

These figures for flowering stems are exceptionally low when compared with recent surveys by Singhurst (1996), who reported populations of *T. texanum* in Cass and Nacogdoches counties of 1000 to 2000 flowering scapes.

3. Table 2 lists the taxa in the different sections of Plots 2 and 4. Counting *Sphagnum*, plots 2 and 4 had 59 species, 50 genera, and 33 families. Plot 4 had 52 species; plot 2 had 37 species. The index of similarity (Sorenson's) between plots 2 and 4 was 67 and between the middle sections of 2 and 4 (where *T. texanum* was) was 65 indicating that both plots were the same community. Seventy percent of these species were found in six baygalls in central Louisiana (MacRoberts et al. 2004) suggesting that these *T. texanum* sites may be part of the general baygall community type that is widespread over much of the West Gulf Coastal Plain (Brooks et al. 1993; Nesom et al. 1997). However, the species has not been found in central Louisiana although there are many baygalls and we have searched for it.

Table 3 examines some of these data further. The upper sections of the plots were the richest, both in number of species and in number of herbaceous species. The lowest section was the least diverse, and the middle section, where *T. texanum* occurred, was intermediate. The lower section was dominated by woody vegetation; whereas the upper section was dominated by herbaceous species. The upper edges of baygalls in the Angelina National Forest are often essentially narrow bogs, with such characteristic bog genera as *Sphagnum*, *Pogonia*, *Eriocaulon*, and *Xyris*. Just upslope of the plots (and of most baygalls in this region) was arenic/grossarenic longleaf pine upland.

The difference in vegetation among the three sections of the plots is undoubtedly due to differences in soil moisture and sunlight. The upper sections received the most sunlight (thinnest canopy and located on the baygall edge next to arenic/grossarenic, relatively open longleaf pine uplands) and had the least saturated soil. The middle section was intermediate, and the lower section received the least sunlight (dense canopy; no open edge) and was often mucky wet.

TABLE 1. *Trillium texanum* developmental stage in seven one meter sq. plots.

Year	single leaf	three leaves	flowering plant
1995	169	3	5
1996	345	3	3
1997	308	10	7

TABLE 2. Vascular plants occurring in three sections of two permanent plots. Plants in plot 2 are designated "2" and plants in plot 4 are designated "4." The sections within each plot are: upper, middle, lower depending on their elevation and proximity to the stream. Nomenclature follows Kartesz and Meacham (1999).

Family/species	Upper	Middle	Lower
Aceraceae			
Acer rubrum L.	24	24	24
Anacardiaceae			
Toxicodendron vernix (L.) Kuntze	24	24	24
Apiaceae			
Centella erecta (L.f.) Fern.	24		
Eryngium integrifolium Walt.		4	
Oxypolis rigidior (L.) Raf.	4	4	
Ptilimnium capillaceum (Michx.) Raf.	4		
Aquifoliaceae			
Ilex coriacea (Pursh) Chapman	4	24	24
Ilex opaca Ait.		24	2
Araceae			
Arisaema triphyllum (L.) Schott			4
Asteraceae			
Arnoglossum ovatum (Walt.) H.E. Robins	4	4	4
Doellingeria sericocarpoides Small		4	4
Eupatorium fistulosum Barratt		24	24
Eupatorium rotundifolium L.	24	2	
Helianthus angustifolius L.	4		
Liatris pycnostachya Michx.	4		
Solidago rugosa P. Mill.	4	4	
Symphyotrichum dumosum (L.) Nesom	4	4	
Symphyotrichum lateriflorum (L.) A. & D. Love	4		
Blechnaceae			
Woodwardia areolata (L.) T. Moore		24	24
Woodwardia virginiana (L.) Sm.	4		4

TABLE 2. continued.

Family/species	Upper	Middle	Lower
Burmanniaceae			
Aptera aphylla (Nutt.) Barnh. ex Small	24	24	24
Campanulaceae			
Lobelia puberula Michx.		4	
Cornaceae			
Nyssa biflora Walt.	2		
Clusiaceae			
Hypericum crux-andreae (L.) Crantz.	2		
Hypericum galioides Lam.	4	4	
Cyperaceae			
Carex glaucescens Ell.	4		
Rhynchospora gracilenta A. Gray	24	4	4
Scleria triglomerata Michx.	4	4	4
Dennstaedtiaceae			
Pteridium aquilinum (L.) Kuhn	2		
Ericaceae			
Lyonia ligustrina (L.) DC.	4	24	
Rhododendron canescens (Michx.) Sw.	24	24	4
Vaccinium corymbosum L.	2	24	2
Eriocaulaceae			
Eriocaulon decangulare Ell.	4		
Lachnocaulon anceps (Walt.) Mrong.	24		
Hamamelidaceae			
Liquidambar styraciflua L.	2		
Lauraceae			
Persea palustris (Raf.) Sarg.	24	24	24
Lentibulariaceae			
Pinguicula pumila Michx.		24	
Liliaceae			
Aletris aurea Walt.	24		
Melanthium virginicum L.	4	4	
Loganiaceae			
Gelsemium sempervirens (L.) Aition.f.	4	24	
Magnoliaceae			
Magnolia virginiana L.	4	4	24
Melastomataceae			
Rhexia petiolata Walt.	24		
Orchidaceae			
Pogonia ophioglossoides (L.) Ker. Ga.	24	24	

TABLE 2. continued.

Family/species	Upper	Middle	Lower
Osmundaceae			
Osmunda cinnamomea L.	4	24	
Osmunda regalis L.	4	24	2
Pinaceae			
Pinus palustris P. Mill.	2	2	2
Pinus taeda L.	4		4
Poaceae			
Chasmanthium laxum (L.) Yates	24		
Dichanthelium dichotomum (L.) Gould	24	24	
Polygalaceae			
Polygala nana (Michx.) DC.	2		
Rubiaceae			
Mitchella repens L.	24	4	24
Smilacaceae			
Smilax laurifolia L.	24	4	4
Trilliaceae			
Trillium texanum Buckley		24	
Verbenaceae			
Callicarpa americana L.		4	
Violaceae			
Viola primulifolia L.	24	4	
Xyridaceae			
Xyris ambigua Bey. ex Kunth	4		
Xyris caroliniana Walt.	2		
Xyris scabrifolia Harper	4		
Sphagnum	24	4	

TABLE 3. Floristic breakdown of plots by section.

Plot 2	Upper	Middle	Lower
Total species in sections:	27	19	13
Total % of all species:	73	51	35
Total woody species:	8	9	7
Total % woody species:	30	47	54
Plot 4			
Total species in sections:	41	35	18
Total % of all species:	79	65	35
Total woody species:	9	11	8
Total % woody species:	22	32	44

TABLE 4. Soil characteristics of two baygalls.

		Exchangeable Ions (ppm)				
Sample	pH	P	K	Ca	Mg	Organic Matter %
Plot 2	5.0	7	21	90	20	4.1
Plot 4	5.2	15	22	110	25	3.3

4. *Trillium texanum* occurred in the Tehran-Letney-Melhomes soil series. These are sandy soils that are deep, gently sloping, poorly drained but rapidly permeable (Dolezel et al. 1988; Neitsch et al. 1982) (Table 4). In the baygalls, these soils are wet most, if not all, of the year. Like bog and baygall soils throughout the West Gulf Coastal Plain, they are acidic and nutrient poor (Nesom et al. 1997; MacRoberts & MacRoberts 2001; MacRoberts et al. 2004).

DISCUSSION

While our observations are local and limited, some ecological information has been gained. In the area of this study, *Trillium texanum* is associated with stream courses, and the typical flora of baygalls that occur below arenic/grossarenic longleaf pine uplands. These sandy uplands hold and slowly discharge water and are often associated with hillside bogs, baygalls, and seepage areas. *Trillium texanum* prefers wet but not inundated soils that are acidic and nutrient poor. It occurs under a deciduous canopy, putting up leaves and scapes in March and April before the canopy blocks light and before other herbaceous plants overtop it. In our study, most of the above-ground vegetation was single leaves with a few scapes. Why these populations should be weighed so heavily in juvenile, non-reproductive individuals, is not known. Habitat preferences and population characteristics in other parts of its range definitely need study before this species complex will be both taxonomically and ecologically understood.

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